D0 note 4497 version 1.0 July 7, 2004

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# Z-coordinate Measurement in CFT and the Track Search

Events collected by DØ become more and more complicated with the rise of the Tevatron luminosity. Each interesting event is overlaid by many minimum bias events, so that the total track multiplicity increases substantially. The DØ tracking system provides in average just 12 measurements per track in the plane perpendicular to the beam direction (axial plane) and a very weak link to the measurements along the beam direction (stereo direction). Therefore, the track search becomes very difficult for events with high multiplicity, with necessity to test a huge amount of "axial"-"stereo" combinations. Additionally, the track density in CFT increases and the different track can give CFT hits in adjacent fibers. They are considered as a single cluster, which spoils the correct pattern recognition.

The proposed upgrade of the CFT, which will provide an additional Z-measurement for each axial hits in CFT, should significantly improve the quality of the track reconstruction. The additional Z-measurements will:

- allow to decouple the adjacent hits in axial plane from different tracks;
- significantly decrease the number of combination of axial and stereo clusters in a given CFT layer.

These improvements can become crucial for the operation of DØ experiment at high luminosity.

To quantify the expected improvements, a special sample of simulated $Z^0 \to \mu^+\mu^-$ events with 15 overlaid minimum bias events was used. Each CFT hit in this simulation also contained the information on Z position of the track with the precision 25 cm, which corresponds to the expected precision of the CFT upgrade. The standard DØ tracking algorithm was applied.

In average, each event contained $\sim 73000$ axial-stereo combinations of clusters in CFT only, because the existing detector gives almost no constraint on the pairing of clusters. Such a high number of combinations results in a significant increase of the time required for the track reconstruction, which was about 100 sec per event at 1 GHz CPU computer.

Then, the track reconstruction algorithm was modified by requiring for each axial-stereo pair:

$$|Z_{ax} - Z_{st}| < 75 \text{ cm}. \quad (1)$$

Here $Z_{st}$ is the coordinate provided by the cluster in the stereo CFT layer and $Z_{ax}$ is the coordinate provided by the axial cluster. The cut value 75 cm corresponds to $\sim 3\sigma$ window

for the cluster selection. This additional condition reduced the number of axial-stereo pairs to $\sim 42000$ per event. Accordingly, the reconstruction time was decreased to 63 sec/event.

The number of reconstructed tracks was slightly decreased from 113 to 92 tracks per event. The detailed study of this loss showed, that it was mainly due to the axial-stereo clusters constructed from 2 or more fibers from different particles. Such clusters have wrong Z measurements and are often rejected by the new condition (1), while the standard tracking algorithm is not sensitive to this wrong pairing. The modified clustering procedure, which takes into account the Z-measurements of axial hits, should restore the tracking efficiency. In addition, it will help to reduce the number of fake tracks by assigning the CFT hits from different tracks to the separate clusters. The modifications in the clustering procedure will require a dedicated study.

If, instead, the cut in condition (1) is set to 50 cm, corresponding to $\sim 2\sigma$ window, the number of axial-stereo pairs was reduced to $\sim 31000$ and the reconstruction time was reduced to 40 sec/event, i.e. about factor 2.5 gain in the speed comparing to the standard reconstruction procedure. However, the number of reconstructed tracks was decreased by additional 10%, mainly due to the discussed above reasons.

In conclusion, the Z-coordinate measurement for the CFT hits can significantly improve the performance of the DØ track reconstruction, by decreasing the time per event up to 2.5 times. An additional modifications in the clustering procedure, taking into account the Z-coordinate information, will be required. On the contrary, the tracking algorithm itself will need only minor changes. Any improvement in precision of the Z-coordinate measurement from currently expected 25 cm will further increase the processing speed and the event reconstruction quality.